Space Weather Technical Forecast

Issued on Monday, 15 August 2022 at 01:19 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Ongoing Active electron fluence. Chance of G1/Minor storm on day 3 (17th). Chance of Moderate flares (R1-R2 Radio blackouts) throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with occasional C-class flares. The largest of these was a C5.3 at 14/1400 UTC from AR3079 (Dai/beta) in the southwest quadrant. AR3081 (Dai Beta-Gamma) is of similar size and complexity. Another region of note is AR3076 (Dao/Beta-gamma) in the northwest, which appears to have a reverse polarity, and this was responsible for a long duration flare that started at 14/1200 UTC and emitted a coronal mass ejection (CME) towards Earth. In the southeast quadrant AR3078 (Cai/Beta-Gamma) is also of note with a rather complex magnetic structure in evidence. It was the source region for a small CME around 13/1700 UTC. This has been analysed and is forecast to primarily pass to the south of Earth on day 3 (17th). The remaining region AR3074 (Hax/Alpha) appears to be the simplest region on the disc. No other Earth-directed CMEs were observed in the available imagery.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, is showing a fast wind environment, with speeds remaining around 500km/s. Density remained at average levels with a slowly declining trend (6-9nT). The IMF was weak throughout with the north-south component varying weakly (+/- 5nT). The phi angle was mostly positive (away from the Sun), but with some brief negative variations. Geomagnetic activity was Quiet to Unsettled (Kp 0-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV), as measured by GOES16, was at Background levels. The high energy electron flux (greater than 2 MeV) was High for a good portion of the period, with a peak of 3.06e3 pfu at 14/1550 UTC, this was after Moderate levels until around 14/0900 UTC. The 24-hour integrated electron fluence was above Active throughout, with an observed value of 1.21e8 integrated pfu at 15/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to remain predominantly Low, but with a chance (30%) of becoming Moderate.

Solar Wind / Geomagnetic Activity: Earth is currently within a high speed stream from coronal holes 10 and 12. The next coronal hole 14 is due to connect with earth's magnetosphere on day 3 (17th), with solar winds likely to become 500-600km/s. This enhancement is likely to be further enhanced by a CME impacting Earth, around the same time frame. This feature left the Sun around midday on the 14th. Geomagnetic activity is expected to be mainly Quiet, with isolated Unsettled intervals through the next two days. On day 3 (17th), activity is expected to become Unsettled to Active, with a chance of G1/minor geomagnetic storms and slight chance of a G2/moderate geomagnetic storm.

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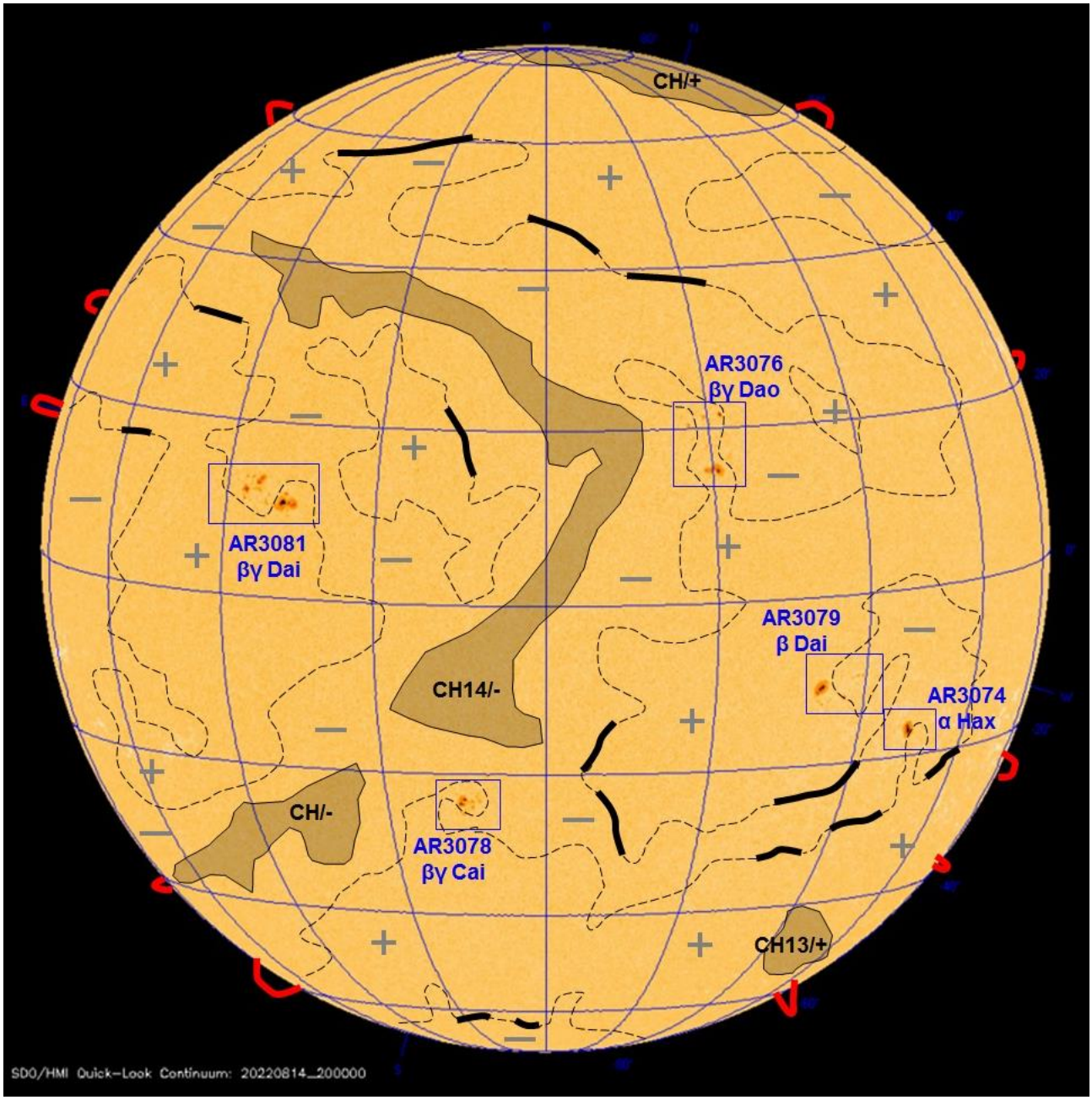
Met Office Space Weather Technical Forecast

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is likely to remain at background levels, although with a slight chance of an S1 or greater event. High energy electron flux is expected to continue at a moderate to High (1e3 pfu) levels through days 1-3 (14th-16th) before becoming suppressed on day 4 (17th). Electron fluence is expected to remain above the Active threshold through much of this period.

Figure 1. Solar Analysis Valid 2000UTC, 14 August 2022.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Solar winds are expected to erratically decline to slightly elevated and perhaps reach slow-ambient levels over the next couple of days as CH12 and CH10 rotate away from a geoeffective position. Coronal hole 14 is then due to connect with the Earth during day 3 (17th), based on a predicted high speed stream of 500-600km/s. This coronal hole is a recurrent feature and thus wind speeds are likely to reach a similar range as occurred with the previous rotation. This enhancement is likely to be further enhanced by a CME impacting Earth, around the same time frame. Along with this there is a chance of further enhancement due to embedded CME effects, from a second CME which left the Sun on the 13th, and this will most likely pass to the south of Earth. However, there is a possibility of a glancing blow, and if this was to occur it would coincide with first CME and the coronal hole enhancement on the 17th. To complicate matters further a third CME looks to have left the sun from an associated C1.37 flare at 14/2154UTC from AR3078. This has yet to be analysed but will probably suffer a similar fate to the second CME and pass below Earth, given the southerly aspect of the source region.
Geomagnetic activity is expected to be mainly Quiet, with isolated Unsettled intervals through the next two days. On day 3 (17th), activity is expected to become Unsettled to Active, with a chance a G1/Minor Storm intervals. There is also a slight chance of a G2/Moderate Storm especially when the CME(s) mentioned above impact Earth.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	10	50	30
Strong	G3	No	1	1	20	5
Severe	G4	No	1	1	5	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
14/1747	Partial halo	AR3076	SW quadrant	620	17/0600UTC	Drawn out C-class flare that was accompanied by Type II emssion.

Figure 2: X-Ray flares plot at GEO with several C-class flares over the past 24 hours.

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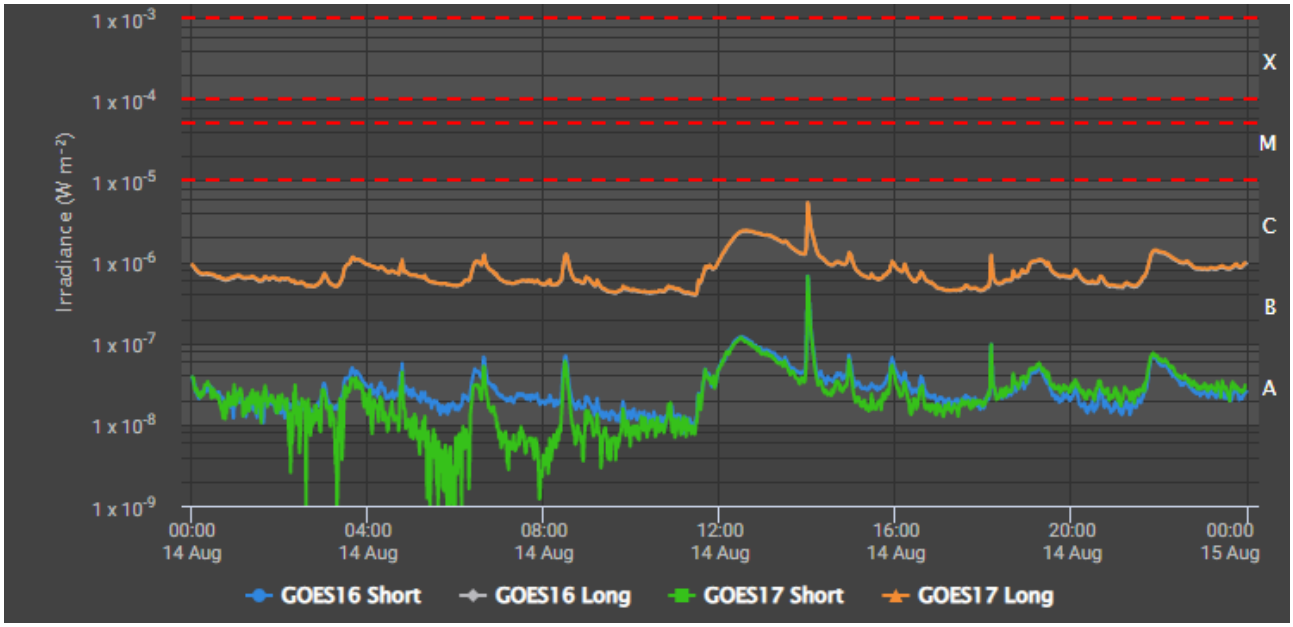

Radio Blackouts - X-Ray Flares:

Solar activity is currently Low, with occasional C-class flares. Activity is forecast to be at mostly Low levels with a chance (30%) of Moderate flares and a slight chance (5%) of X-class activity. The largest flare observed over the past 24 hours was a C5.3 at 14/1400 UTC from AR3079 (Dai/beta) in the southwest quadrant. AR3081 (Dai Beta-Gamma) is of similar size and complexity. These two aforementioned regions appear to give the highest risk for flares. Another region of note is AR3076 (Dao/Beta-gamma) in the northwest, which appears to have a reverse polarity, and this was responsible for a long duration flare that started at 14/1200 UTC and emitted a coronal mass ejection (CME) towards Earth. In the southeast quadrant AR3078 (Cai/Beta-Gamma) is also of note with a rather complex magnetic structure in evidence.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	5	5	5	5

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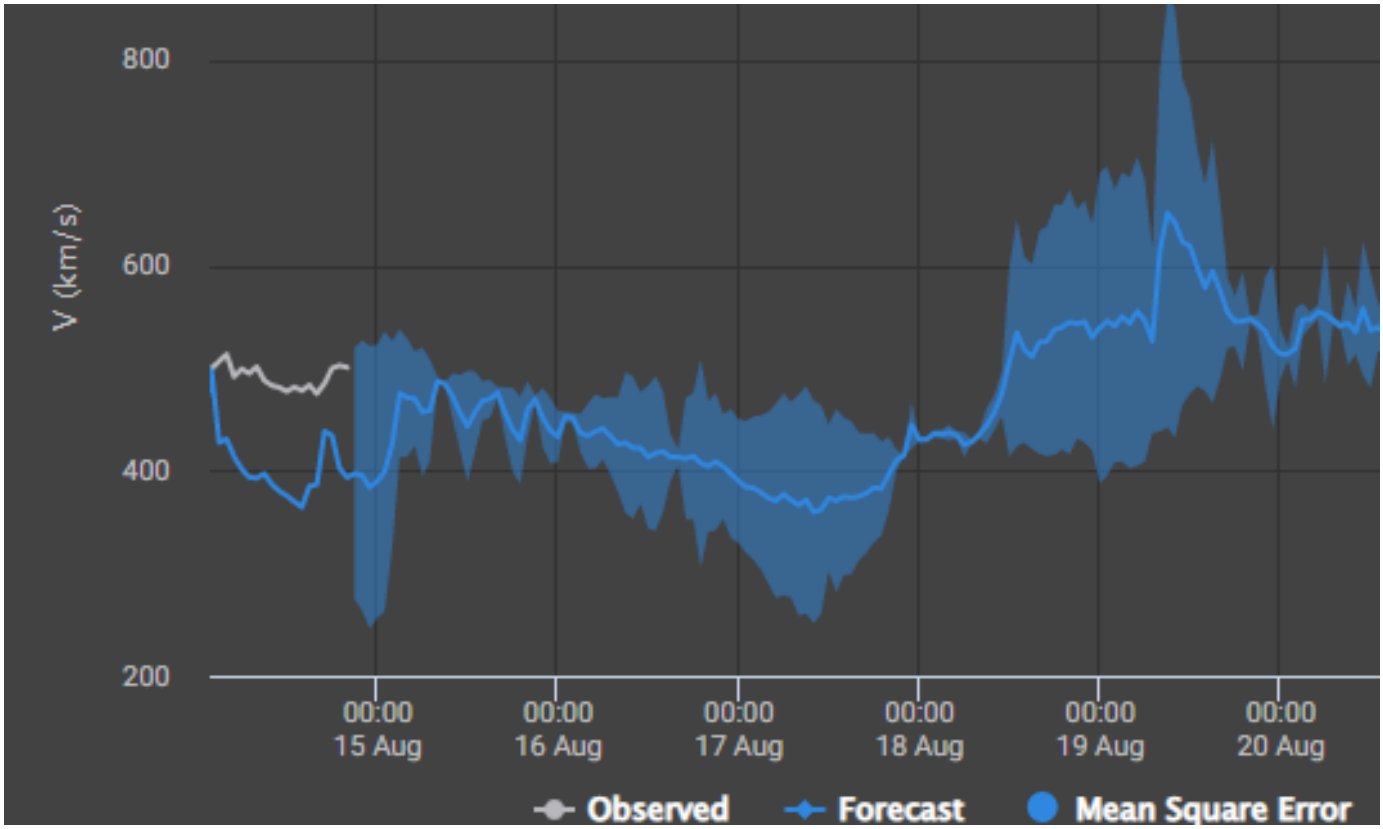
Solar Radiation Storms - (High Energy Protons):
The high energy proton flux (greater than 10 MeV) is currently at Background levels, and is likely to remain at this level through the period.
Both AR3076 and AR3079 have a very slight risk of proton events and are now in the western hemisphere. Another region worth mentioning is AR3081and this is one to watch, although this is currently in the eastern disc. There is a slightly increasing risk of an S1 or greater event over the four days as this region moves towards centre disc.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	2	3	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 3: Met Office SWPM (Solar Winds Prediction Model) with a decline depicted for much of the period The increase on day 4 18th is considered to be too delayed by around 24 hours.



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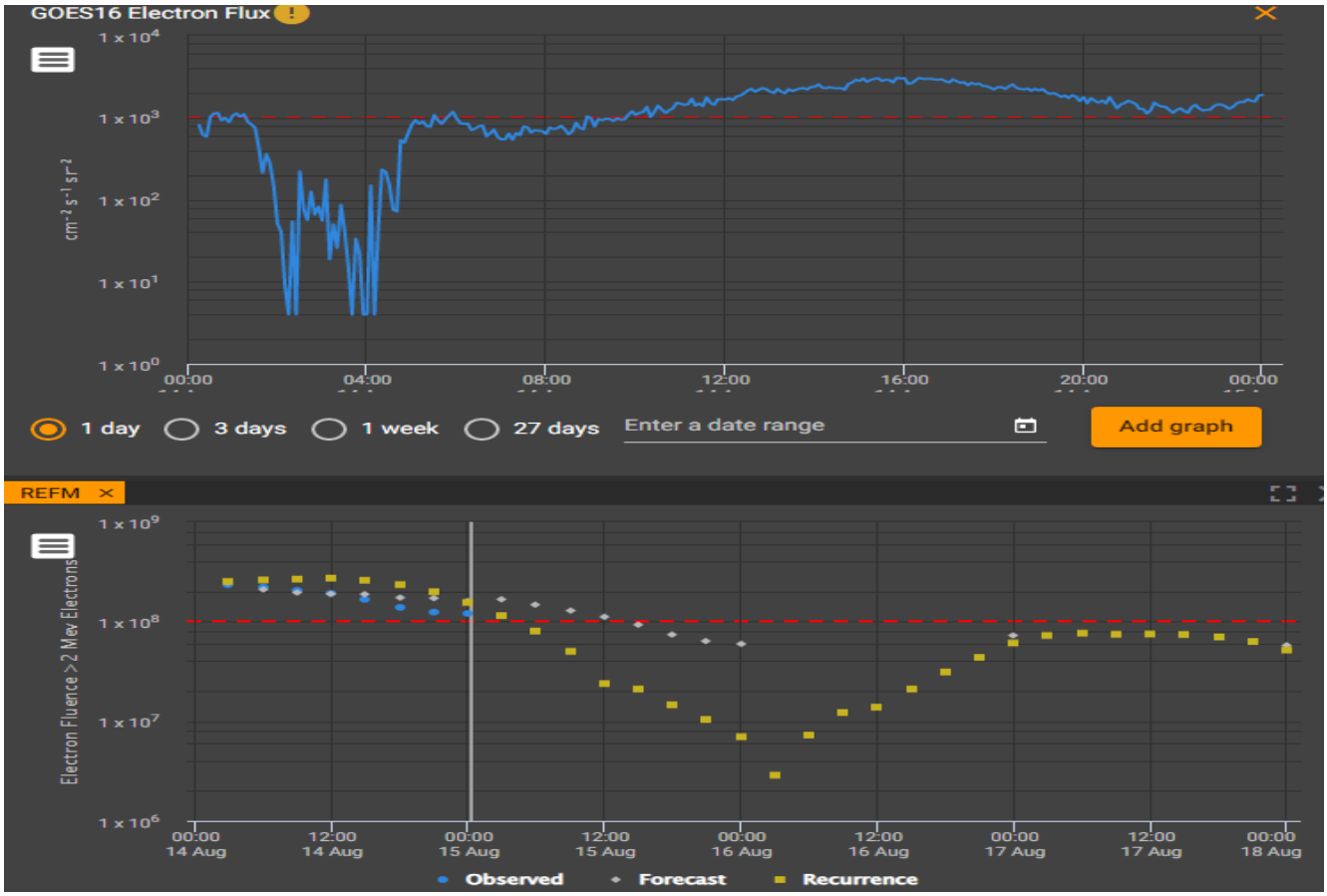
High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) is expected to be at moderate to high levels throughout the next two days, with this occurring during the diurnal peak. On day 3 (17th), electrons are expected to become suppressed due to the expected increase in geomagnetic activity associated with the arrival of the coronal hole enhancement and the CME(s).
Electron fluence values could be above the Active threshold to start the UTC day of day 1 (14th) and the Met Office REFM output appears to be offering sensible guidance, with a probable decline in levels of activity as depicted by the values of occurrence. An uptick in activity is then probable on day 4 (18th) from the anticipated elevated solar wind regime which should be well established by that time.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	90	40	10	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: High energy electron flux (>2MeV) at GEO and the Met Office REFM output.



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